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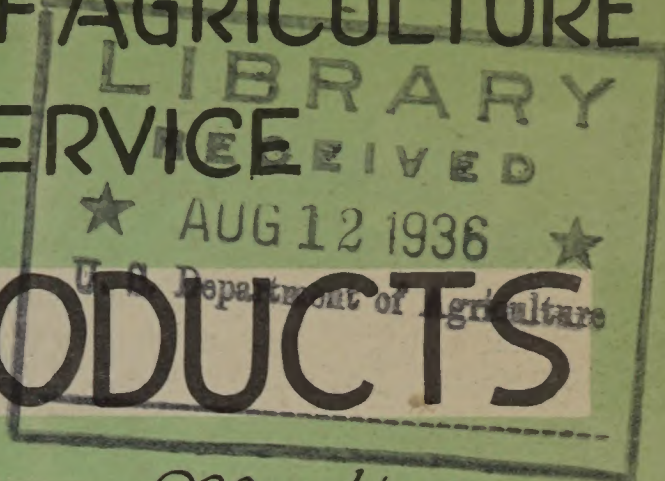
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U.S. DEPARTMENT OF AGRICULTURE  
FOREST SERVICE

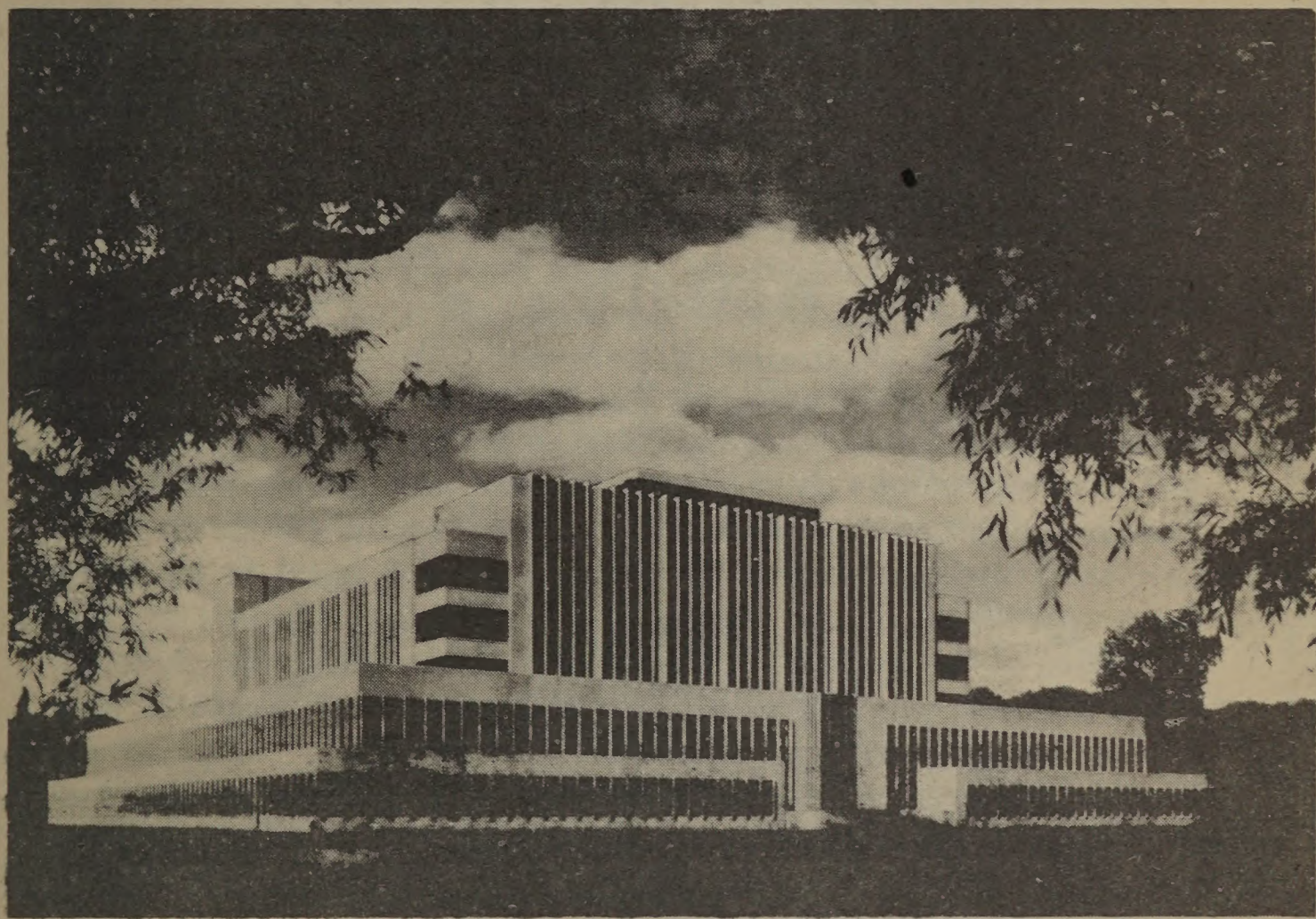


# FOREST PRODUCTS

# LABORATORY

*Madison,  
Wisconsin*

519357



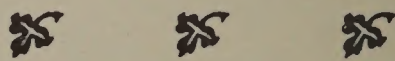
*Maintained In Cooperation With  
The University of Wisconsin —*

FORESTRY IS THE PRESERVATION OF FORESTS BY WISE USE"





## Forest Utilization Serves Economic and Social Welfare



**F**ORESTRY is responsible to the American people for the productive use of hundreds of millions of acres of land—use which will return positive values in employment and human well-being. The major purpose of restoring and developing forests on those vast land areas which agriculture does not need is to make them contribute to the secure and permanent support of their fair share of the country's population. Essential to this objective is the efficient harvesting of the timber crop and its conversion into an immense volume of useful products.

The proper adaptation of wood to modern needs is of primary importance to the average citizen and consumer, whose housing costs and living standards are bound up with a continuing supply and satisfactory use of wood products; to the workman, who needs the billion dollars' worth of employment given by the sawmill, the pulp mill, and wood manufactures; to the farmer with his 125 million acres of woodlands; to local communities, counties, States and the Nation, which have a vital interest in stable revenues from forests, forest lands, and successful forest enterprises.



# Improved Utilization Of Wood Is Aim Of Forest Products Laboratory

ESTABLISHED in 1910 as an integral part of the United States Forest Service, the Forest Products Laboratory is a scientific and technical research institution whose business is to aid in protecting and enhancing the value and utility of forest products. The work of the Laboratory is therefore directed toward more profitable wood utilization—toward elimination of waste and reduction of costs in logging, in manufacture, and in the utilization of wood products; toward increasing the serviceability and satisfaction of forest products to the user; and toward the development of new and useful products from wood.

The service rendered by the Laboratory is a public service. Its activities are fully coordinated with the rest of the Forest Service in working to perpetuate the forests for the use of the American people and nation. Acting upon the principle that forestry is the preservation of forests by wise use, its research is constantly directed toward insuring to the American people the maximum of values and services from the innumerable products which the forest can supply.

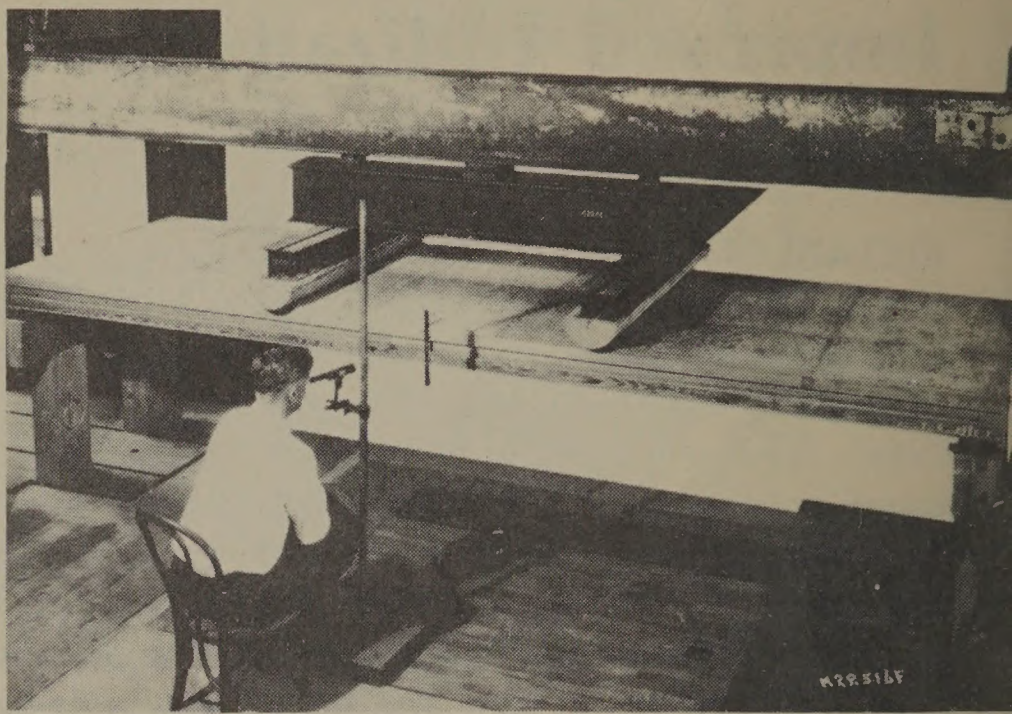




## STRENGTH OF WOOD DETERMINED FOR ALL TYPES OF SERVICE    ○ ○ ○ ○

**M**ORE than 600,000 mechanical tests have been made at the Laboratory to determine the strength characteristics of more than 160 native woods, for the purpose of adapting wood more effectively and satisfactorily to its various uses.

The photograph at the **BOTTOM** of the page is a general view of the timber testing room. The picture at the **TOP** shows a new type of floor panel being tested. The new unit is made of plywood and is considerably stronger than an ordinary floor panel of the same dimensions. **CENTER** photographs show two crates used for shipping incubators. The one at the left was the original crate as received for test, and the one at the right is the crate as redesigned by the Laboratory, which tested 42% stronger. As a result of the Laboratory's boxing and crating investigations, claims against railroads for damage to goods in transit were reduced by \$37,000,000 between 1920 and 1930.





## IMPROVED SEASONING METHODS MEAN BETTER HOMES, FURNITURE, WOOD PRODUCTS . . .

**P**RACTICALLY all wood must be seasoned before use. Improvements in seasoning and related processes are reflected in lowered costs, reduced losses of material, increased value of the product, and more satisfaction in use. If wood did not shrink as it dries, the seasoning problem would be simple; but uncontrolled shrinkage causes checks and splits, cupping and warping, honeycombing and casehardening, and means are required to avoid such damage during the removal of moisture from the wood.

It has been estimated that developments in wood seasoning processes at the Laboratory save wood users \$10,000,000 annually in America in better lumber and fabricated products. Ten of the most completely equipped dry kilns ever installed for experimental service are a part of the equipment. The TOP picture on this page shows a smoke test of the air circulation in a Laboratory dry kiln. **BELOW** is a picture of a large commercial installation of dry kilns designed and operated on principles developed at the Laboratory.

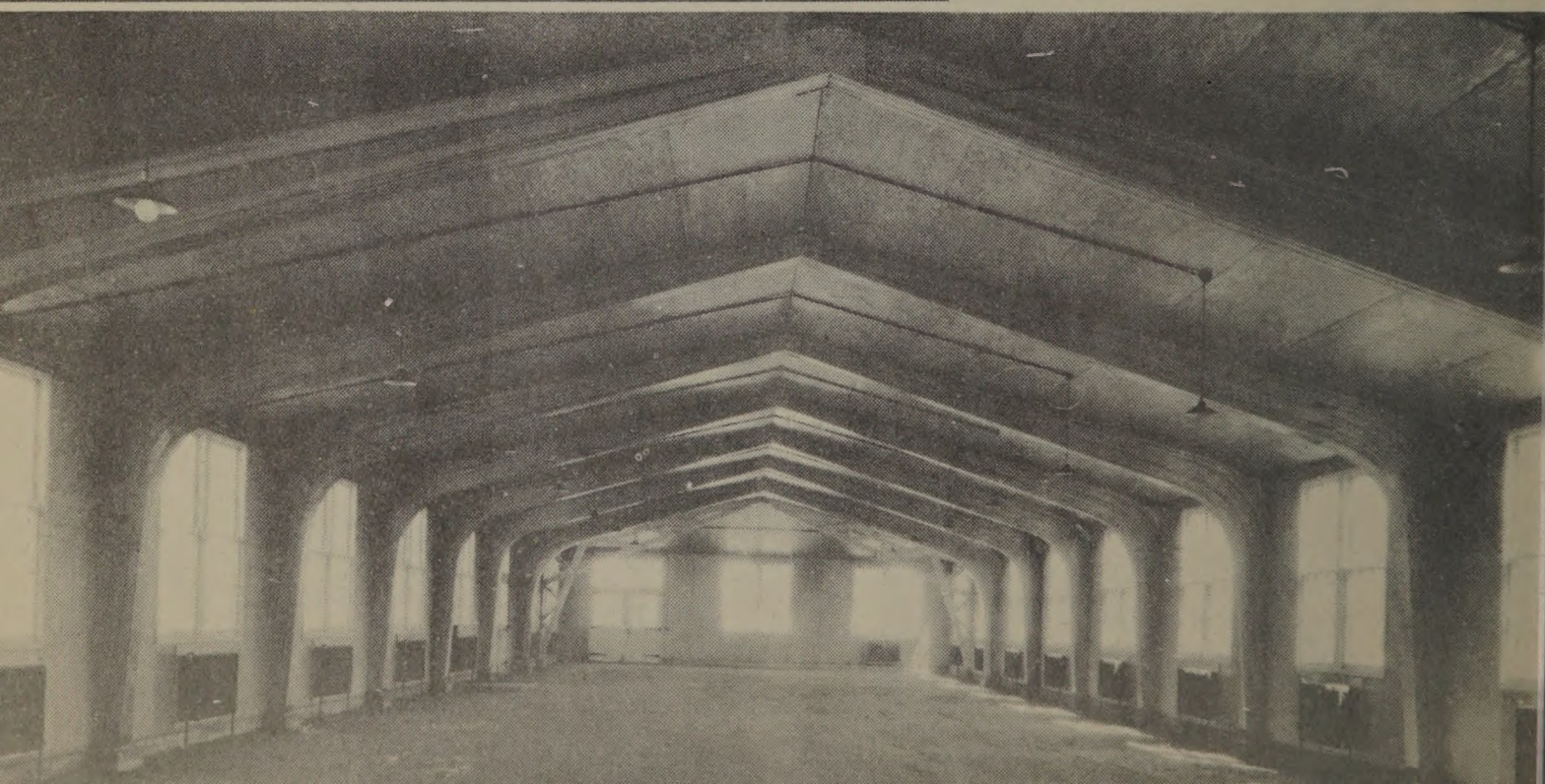
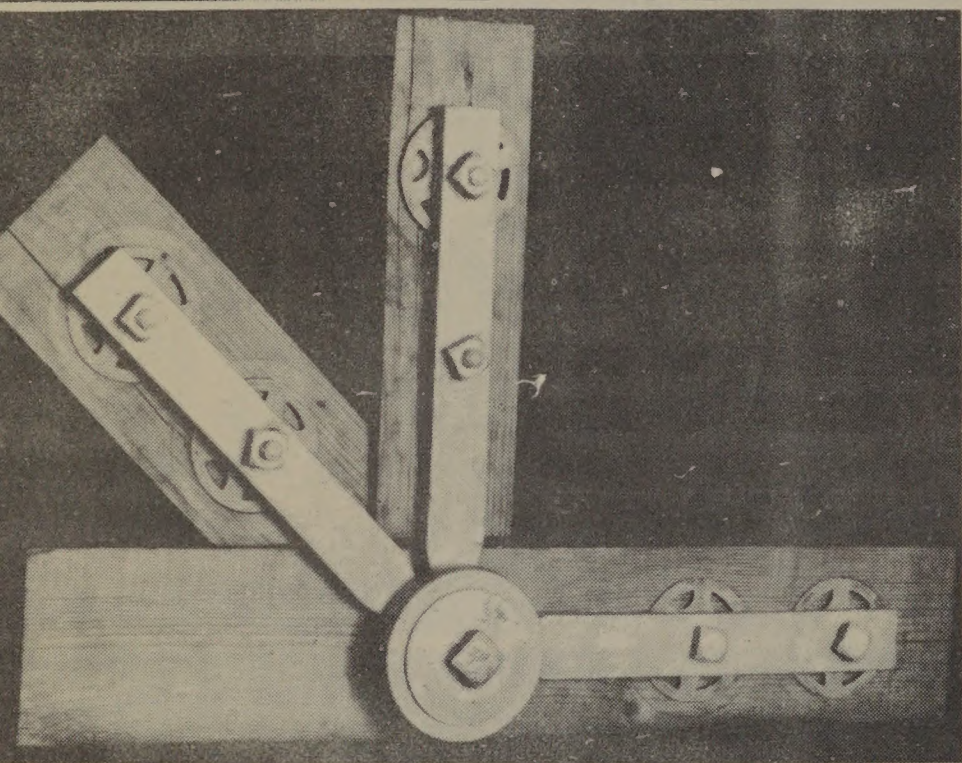
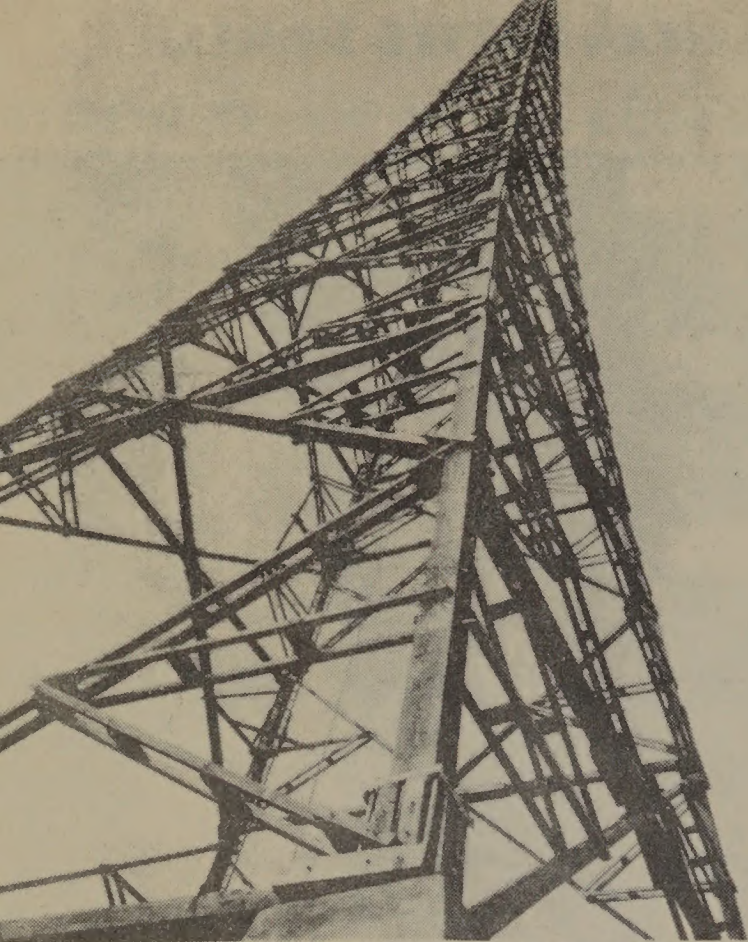




## PREPARE WOOD TO MODERN BUILDING

SINCE early days, wood has provided Americans with homes, stores, farmsteads, and factories. Step by step with the development of the country it has sheltered man's activities. Over half of all the wood cut from the forests still goes into building and housing. But in recent years wood construction has lagged and other materials have come in, because antiquated, inefficient wood building methods have persisted. Mills have closed, thousands of forest workers have been thrown out of employment, and potential forest areas lie idle.

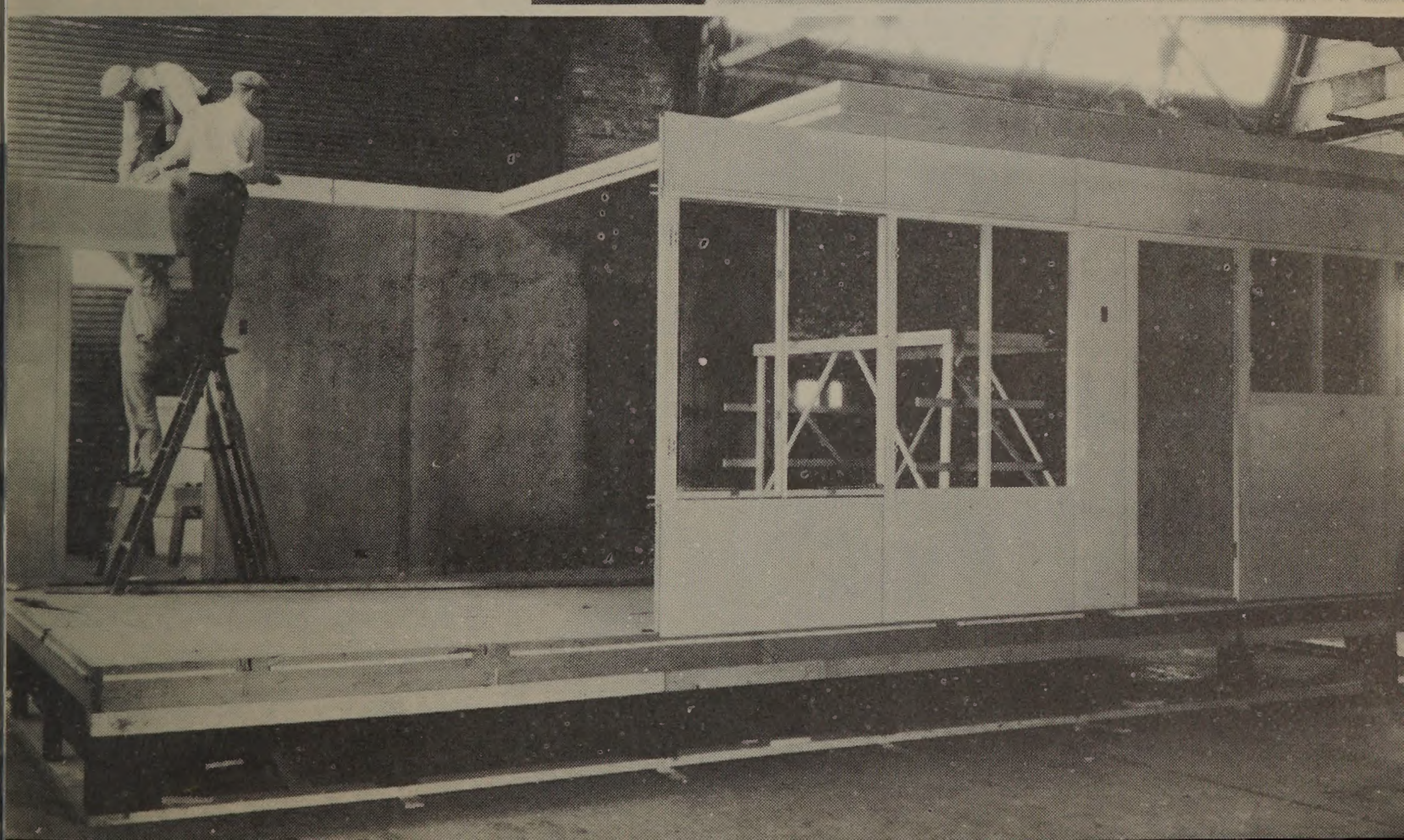
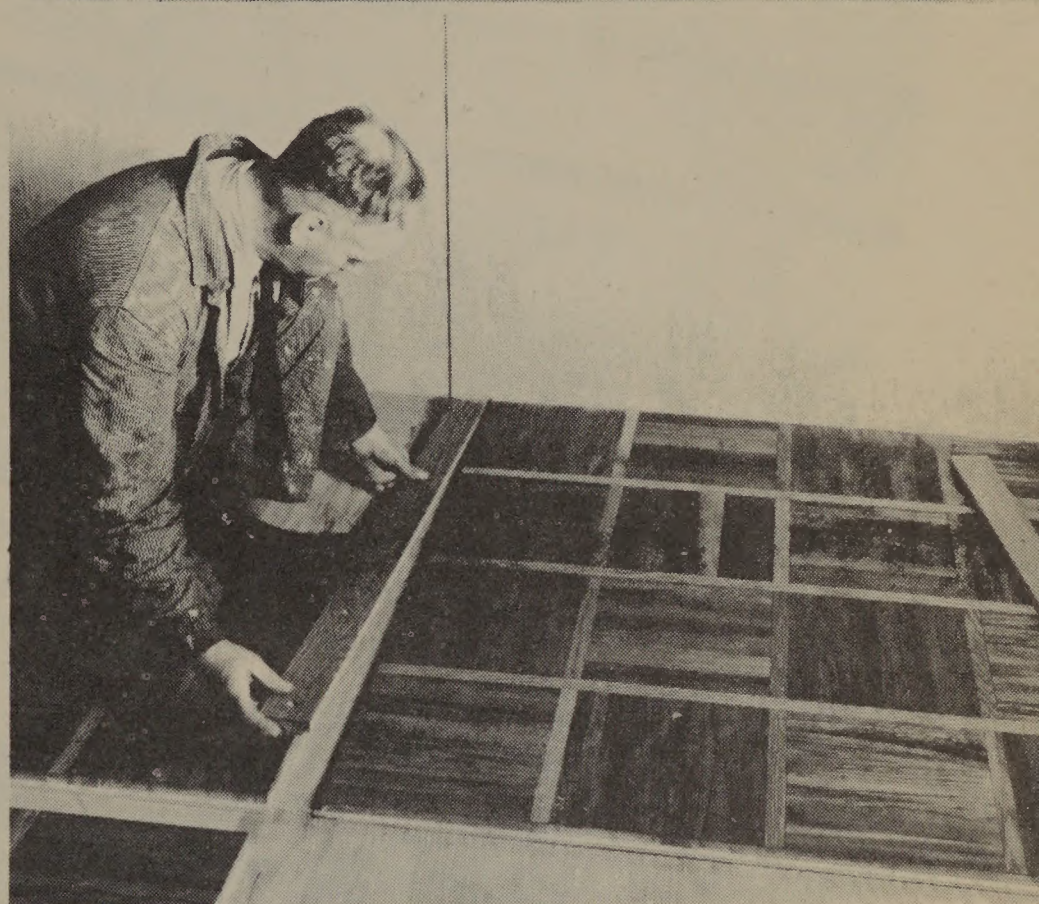
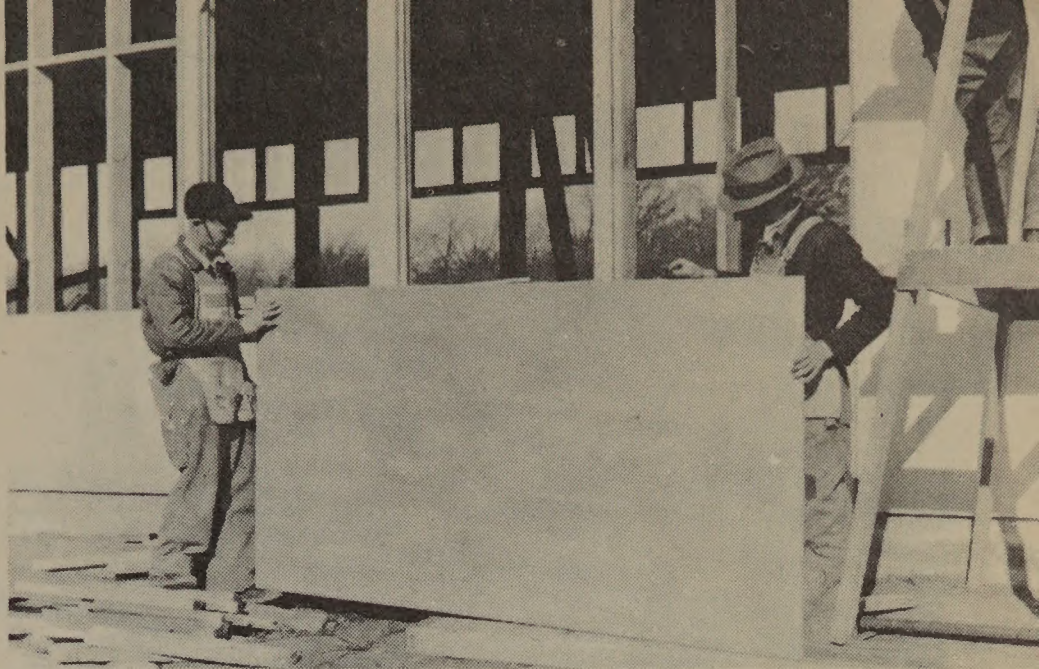
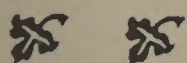
But the service of wood in housing is by no means ended; never was





## MEET TREND OF REQUIREMENTS

the need for homes and buildings greater, and wood is being prepared to meet modern construction requirements. On this page are shown new fastenings for timber framing, efficient glued wood arches for industrial construction, and a new all-wood prefabricated house construction system. Developments along these modern lines that are being followed up at the Forest Products Laboratory will maintain the usefulness of wood in building, its most important service to the Nation.

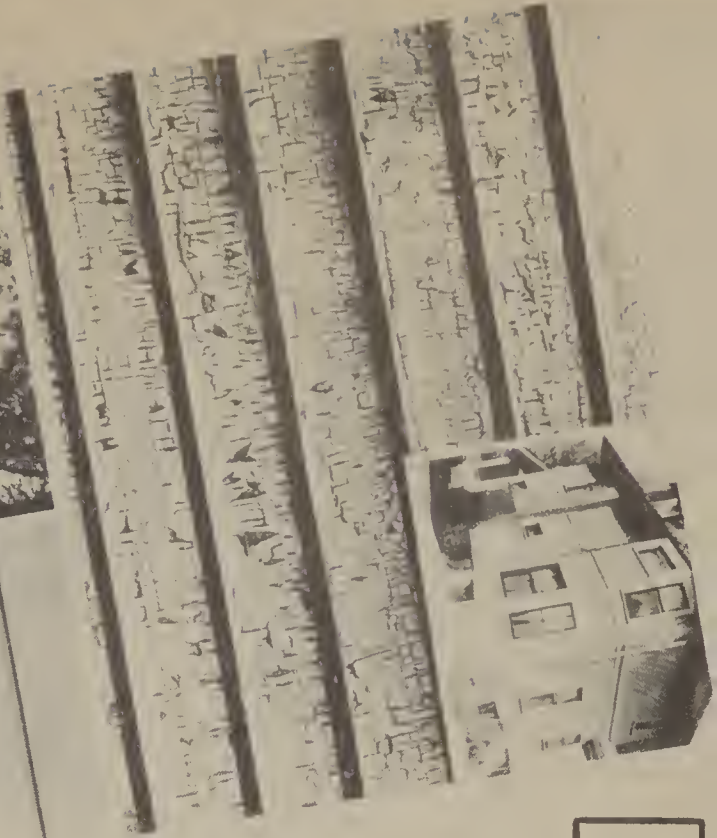




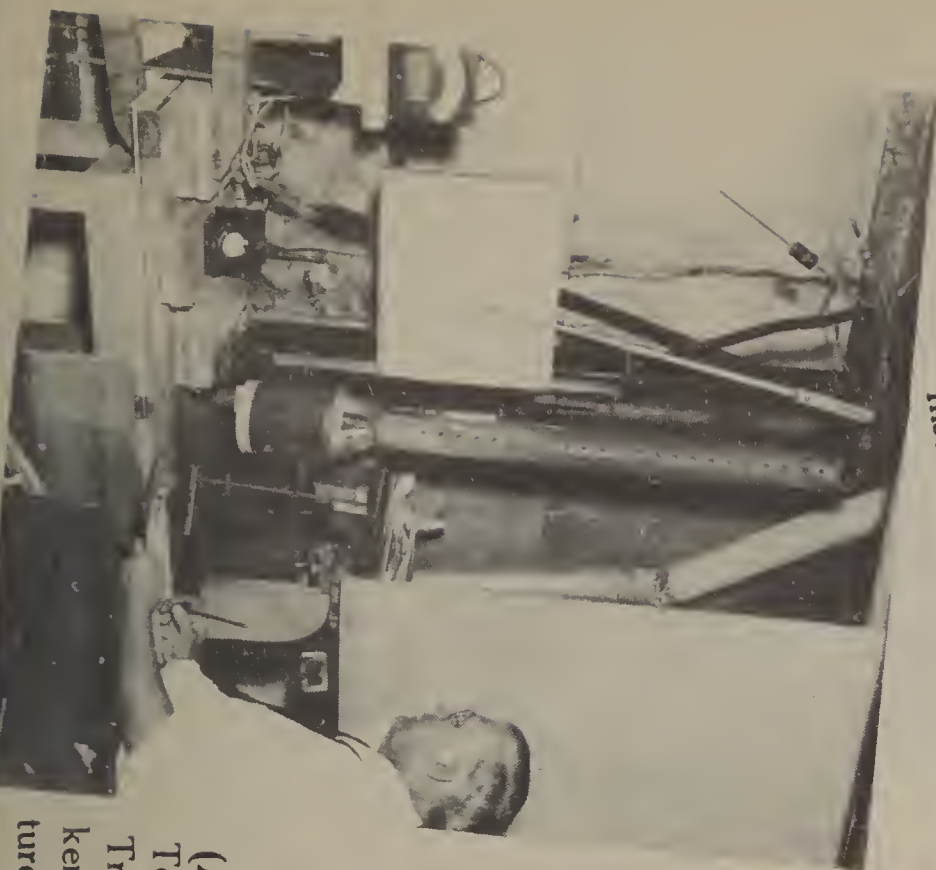
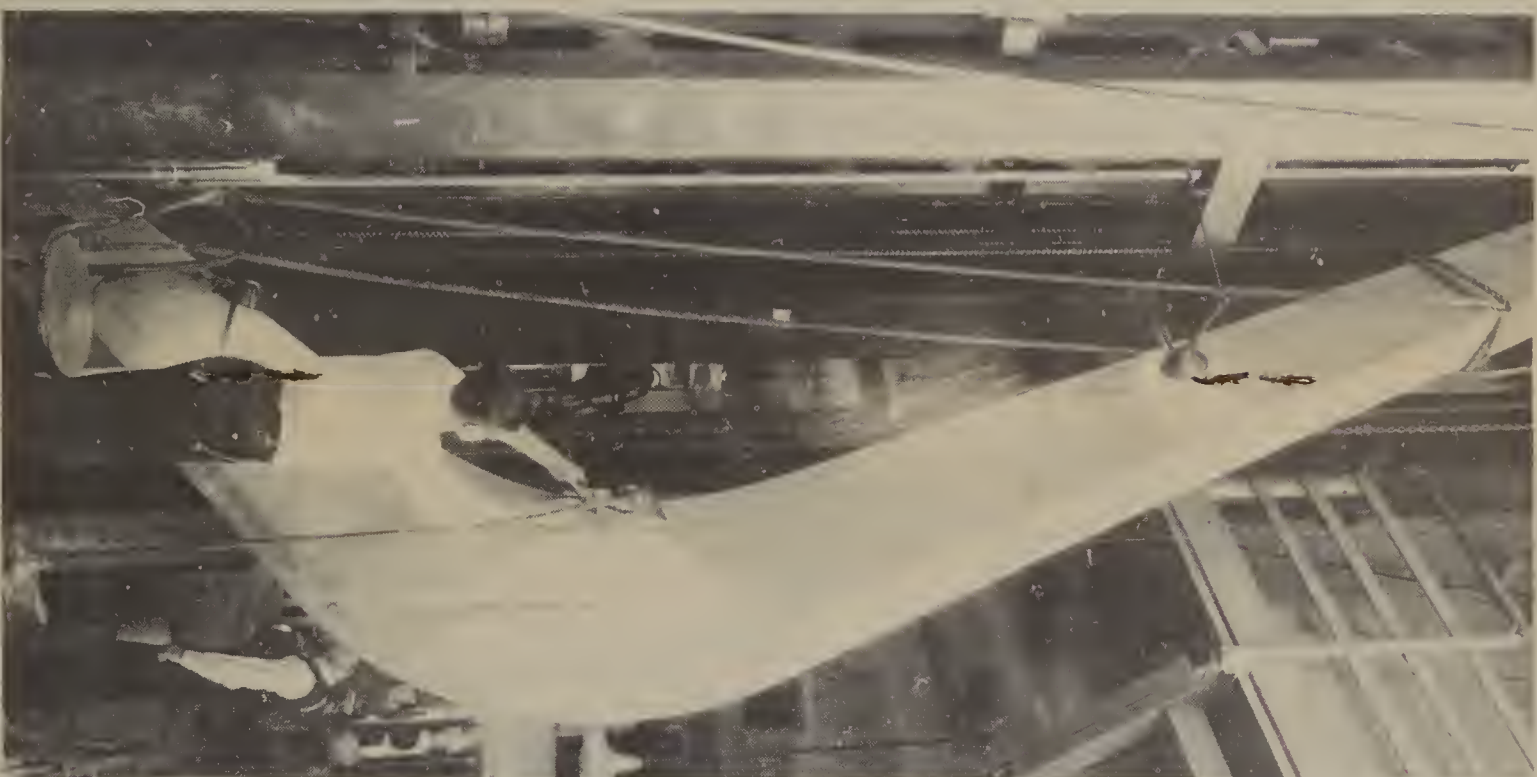




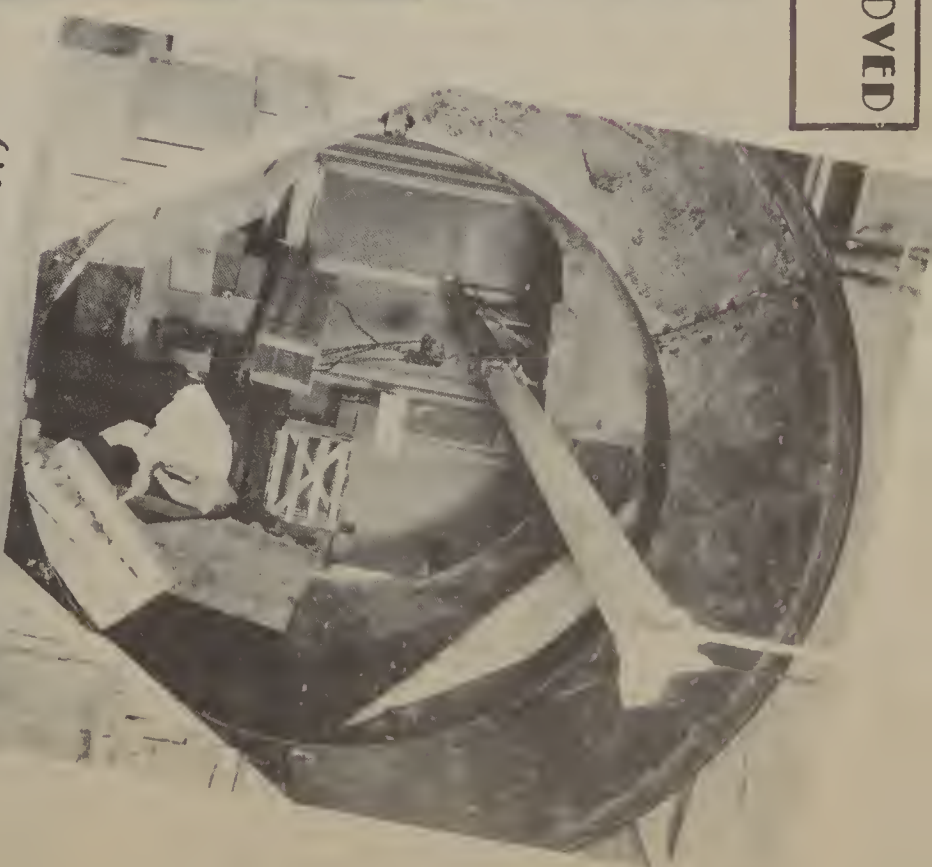
# LABORATORY RESEARCH AIDS IMPROVED SERVICE OF WOOD



How to Avoid Paint Cracking and Blistering (above) to Insure Good Painting (below)



(Above) Testing Laminated Arch in 1,000,000-Pound Testing Machine. (Left) Conducting Tests on Wood Treated with Fire Resisting Material. (Right) The Blinker Machine that Indicates Instantly the Amount of Moisture in Wood.



(Above) Box-Testing Drum.





# SEEK PROTECTION OF WOOD AGAINST DECAY, FIRE, INSECTS, MOISTURE



UNPROTECTED wood in service is being lost through premature decay at a rate equal to the destruction caused annually by forest fires. At the same time, the decay menace is a potent factor in unsatisfactory service and loss of wood markets.

Research in wood preservation has been conducted by the Forest Products Laboratory since its beginning. The effectiveness of preservatives is tested and then checked by thorough trials under actual service conditions. With preservation studies is associated constant research looking to the preparation or modification of wood for better service. Fireproofing and paint investiga-

tions stand high in potential importance. The painting of houses and woodwork is an item of maintenance that often amounts to half the annual tax bill. As a result of exposure tests of painted panels throughout the country, the Laboratory has developed methods which in many cases may double the life of the usual paint job. The UPPER picture on this page shows wood treated with wax by a new method to prevent moisture absorption. In the lower LEFT corner logs are being placed in a chamber for preservative treatment. At the RIGHT is a picture of a machine used in testing the effectiveness of gluing.



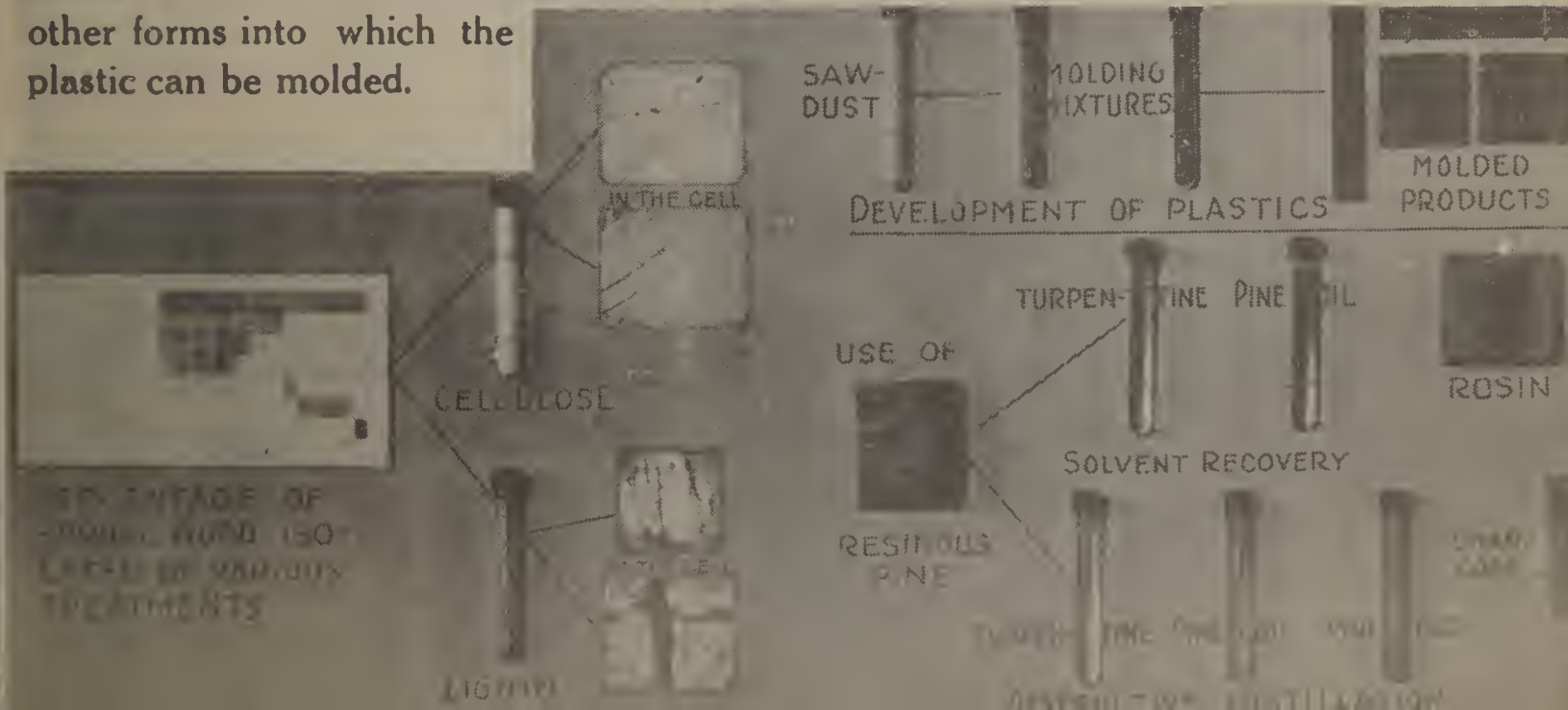


# CHEMISTS SEE WOOD AS A STOREHOUSE OF RAW MATERIALS ONLY PARTIALLY DEVELOPED

WOOD may be analyzed, broadly, as cellulose and lignin, with extractives or infiltrated substances such as resins, gums, tannins, waxes, or the like present to a greater or less extent.

Cellulose, the most abundant constituent of wood, is the cotton-like substance of the fiber, which is the basis of refined paper pulps and other modern products such as rayon, viscose, lacquers, cellophane, etc. Lignin is the material chiefly found surrounding cellulose fibers. Its chemical characteristics are being closely studied with a view to the development of new products from it. As it comprises practically one fourth of the original wood, the need of its utilization or recovery is evident.

The picture at the BOTTOM of the page is a diagram of the composition of wood and some of its derivatives, together with microscopic views of cellulose and lignin after chemical separation in the wood cell. At the TOP of the page is seen a chemist preparing sawdust to be converted into a new type of plastic material. The CENTER picture shows some of the floor tile and other forms into which the plastic can be molded.



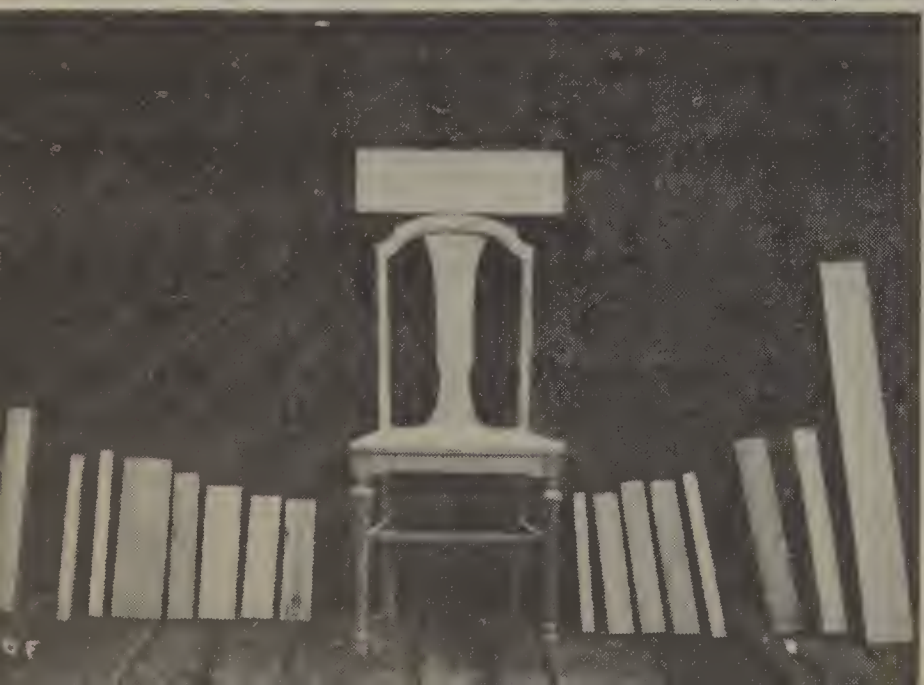


## LABORATORY FINDINGS AID EFFICIENT PRODUCTION IN FOREST AND FACTORY

CARRYING the work of the Laboratory into the commercial field of lumber production and use, the division of Industrial Investigations is organized for fact-finding and interpretation of scientific studies in woods, mill, and factory. Research projects to reduce the per-

centage of waste in harvesting the forest crop approach the problem from several directions the use of less destructive machinery, the conversion of woods and mill waste into useful products, and profitable alteration of the form of the product, as in the sawing of small dimension stock instead of lumber. In all these respects the studies of the Laboratory have made large contributions to industrial practice.

The picture at the TOP of the page shows an example of "clear cutting," where all trees are cut regardless of size and the land will be unproductive for years to come. The picture BELOW shows an example of selective cutting, where only the larger, profit-yielding trees are cut and the smaller ones are left standing to maintain growth and yield later harvests. The Laboratory has given practical guidance in forest conservation in showing the financial advantages of selective cutting. The picture at the BOTTOM of the page illustrates the possibilities of manufacturing chairs or other articles from small dimension stock. Much material that would otherwise be wasted can be utilized as small pieces, whereas using full-sized clear lumber to make the small parts causes a much heavier drain on the forest.



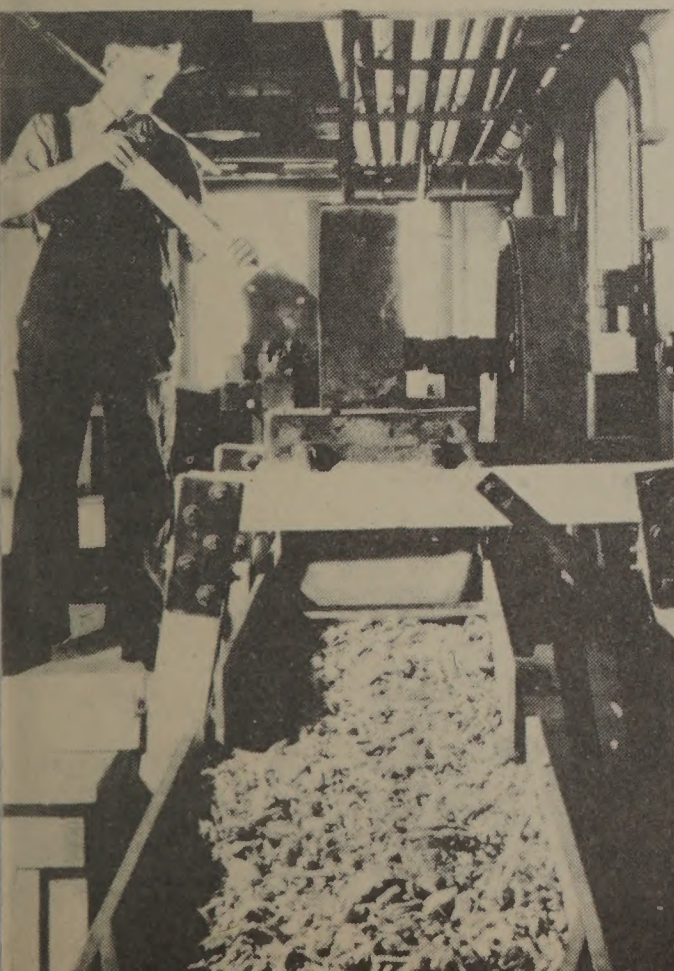
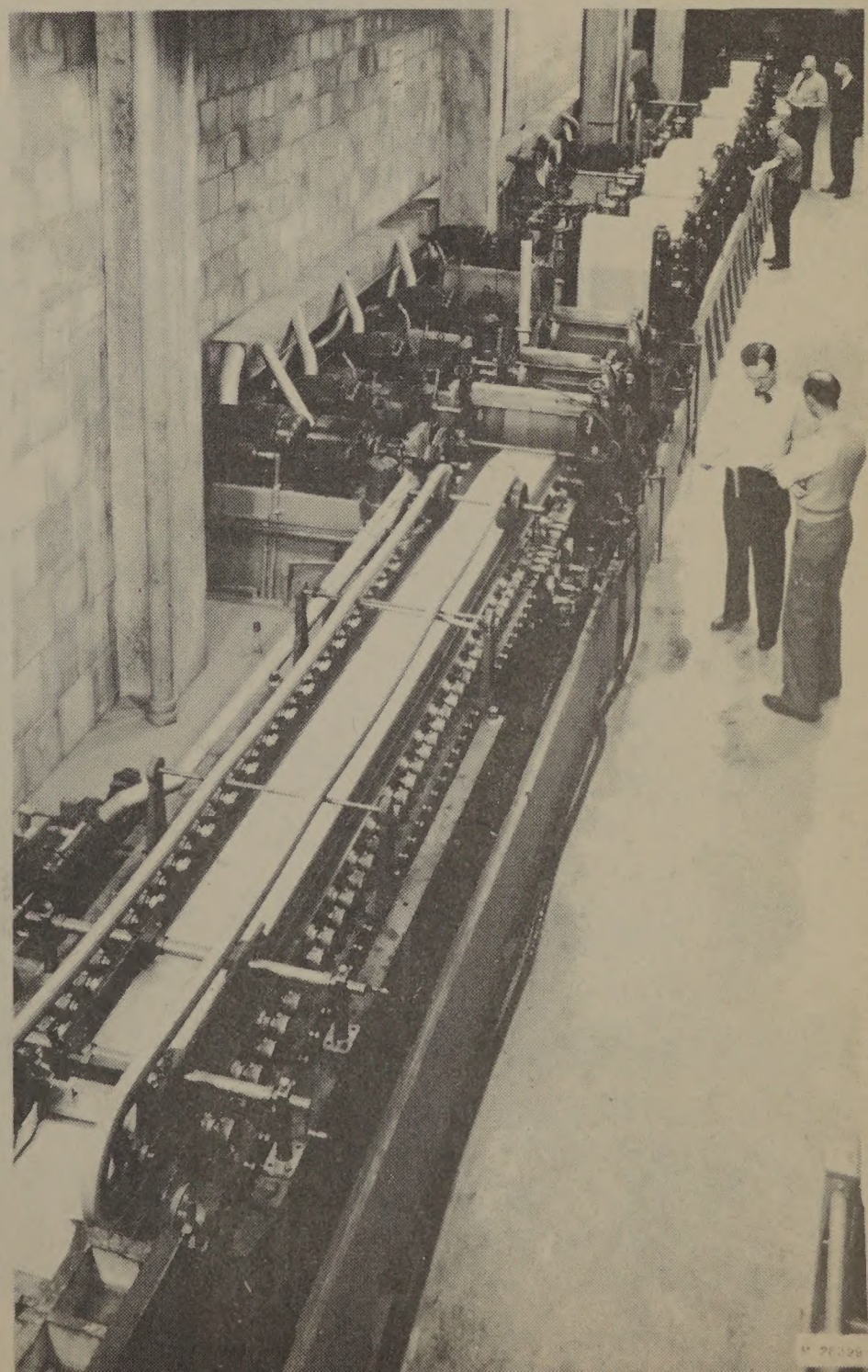


## GREATER USE OF NATIVE WOODS, AIM OF PULP AND PAPER RESEACH

**M**ILLIONS of tons of pulp and paper are imported into the United States annually from abroad, while millions of cords of native woods go to waste with no return in products or employment. More effective use should be made of our own forest resources in this field.

Noteworthy has been the work of the Laboratory in showing how to produce white papers from Southern pines, in the conversion of wood wastes into serviceable paper and boards by a combination of chemical and mechanical treatments, and in exploring the possibilities of some 100 American wood species as pulp and paper material.

In the picture **BELOW**, wood is shown being reduced to chips preparatory to pulping. The picture at the **TOP** of the page shows chips being placed in a chemical digester. At the **BOTTOM** of the page is shown the experimental Fourdrinier machine for converting the pulp into finished paper.





# QUALITY OF WOOD AND WOOD PRODUCTS LINKED TO FOREST GROWTH AND MANAGEMENT . . .



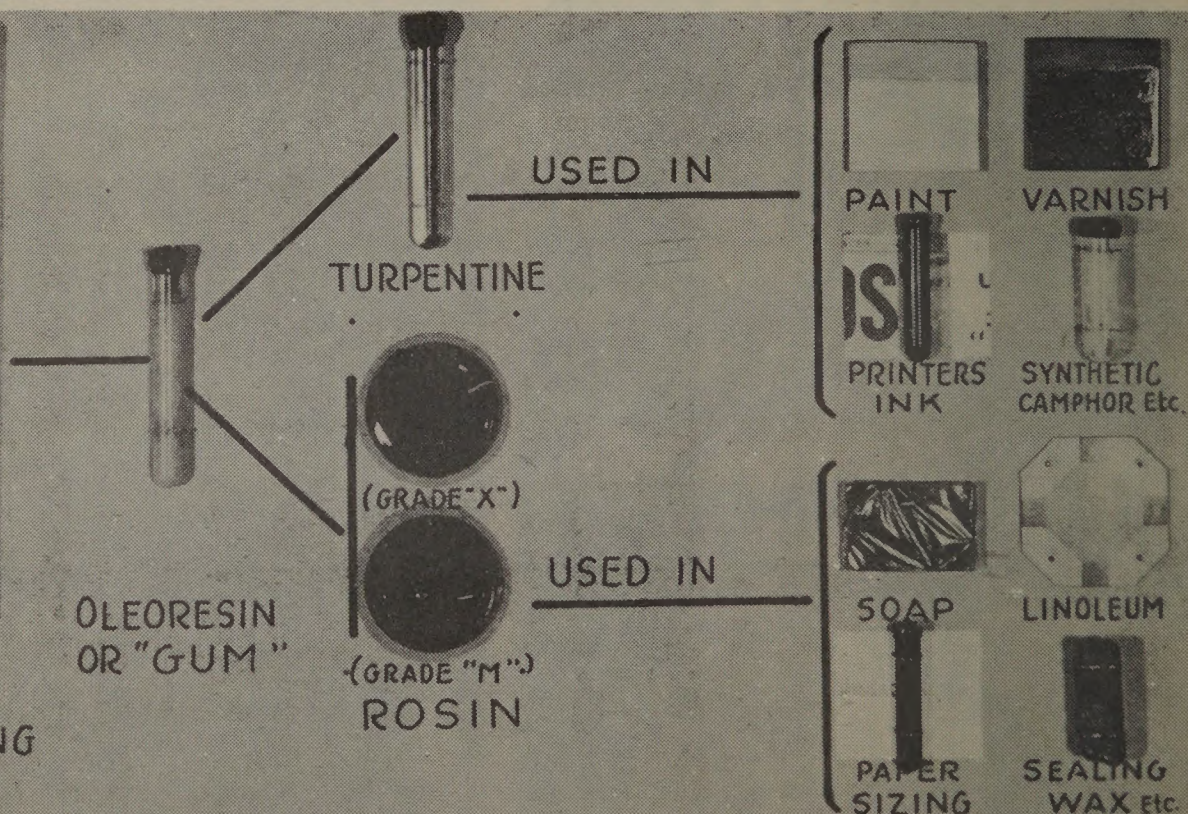
IT is one of the functions of the Laboratory to find out what influence various environmental conditions have on the quality of wood and consequently on its usefulness and value. Research along these lines is of importance in growing timber so that wood of desired properties can be produced in the shortest possible time.

A major forest industry of the United States is the production of gum resin and turpentine, the "naval stores" of commerce, from longleaf and slash pines of the South. The Laboratory, collaborating with other Forest Service units, has shown the practicability of maintaining the flow of oleoresin by light, narrow chipping at as high a yield as by heavier chipping.

TOP picture shows a portable pruning saw developed by the Laboratory. Pruning enables the tree to grow wood free of knots, so that marketable lumber is produced at an early age. BELOW is an illustration showing the source of supply of gum resin and turpentine and some of the products depending upon them.



THE SOURCE OF SUPPLY — REPEATED WOUNDING OF THE TREE

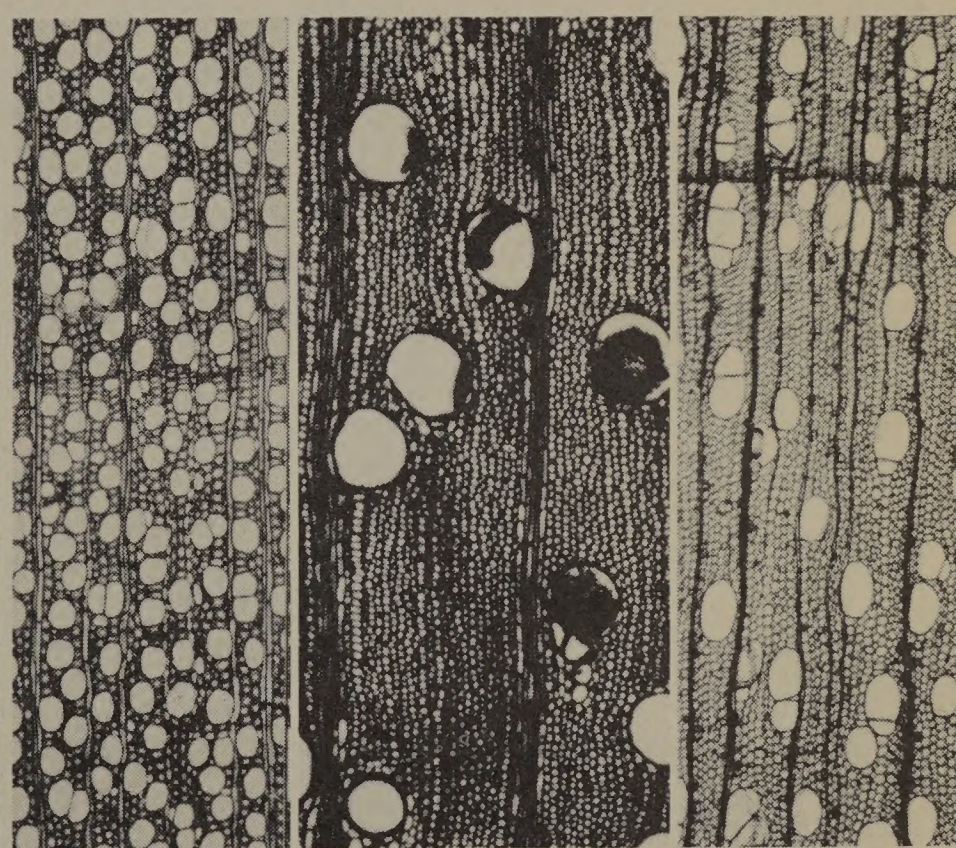
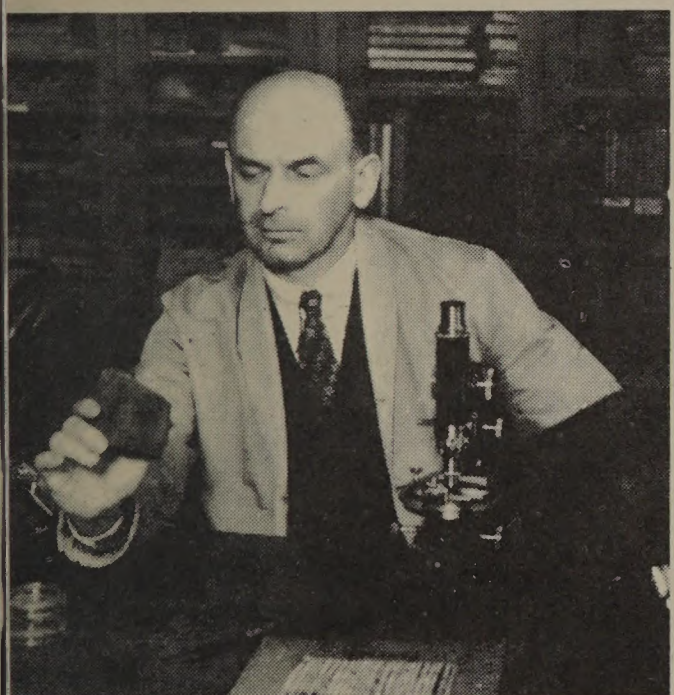
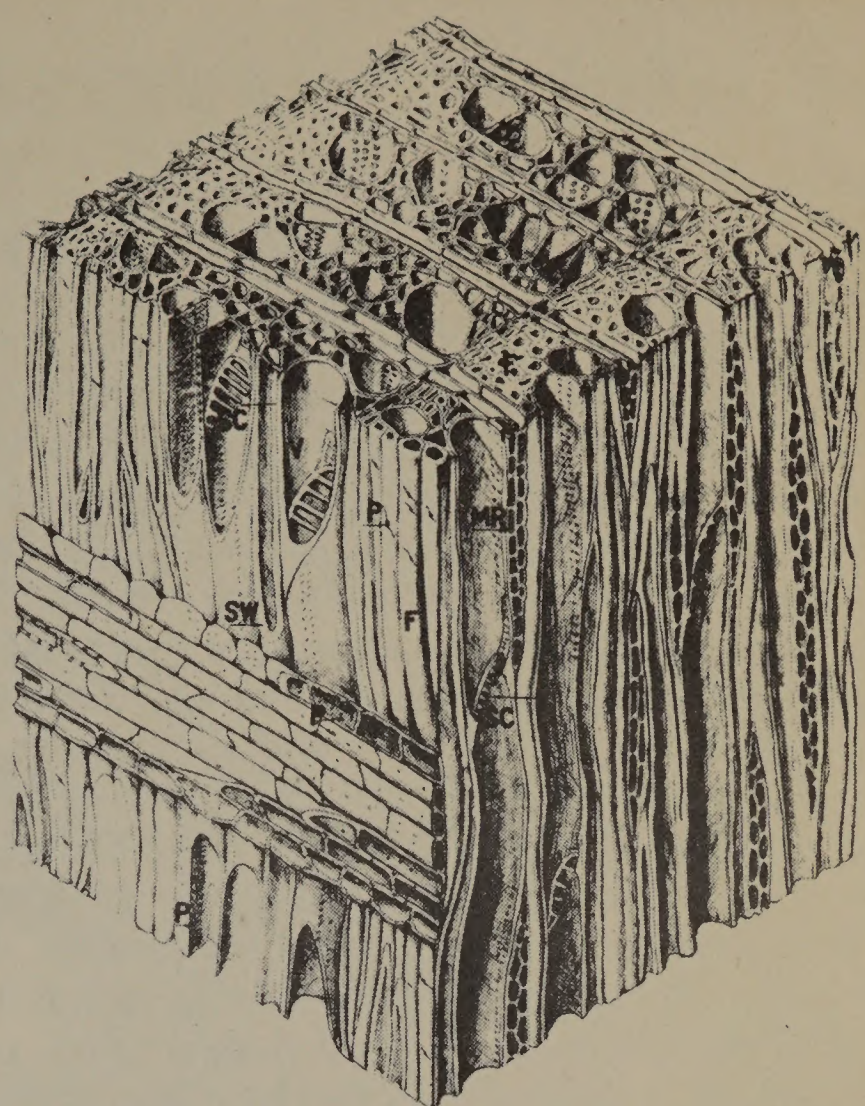




# READ HISTORY OF WOOD IN ITS STRUCTURE . . .

**S**PECIALIZED service in wood identification is offered by the Forest Products Laboratory. About 3,000 samples per year are received. Frequently important questions of commercial use and even lawsuits hinge on the result of an examination of a few chips or shavings, sawdust or wood flour. In criminal cases the careful identification of wood may furnish valuable evidence.

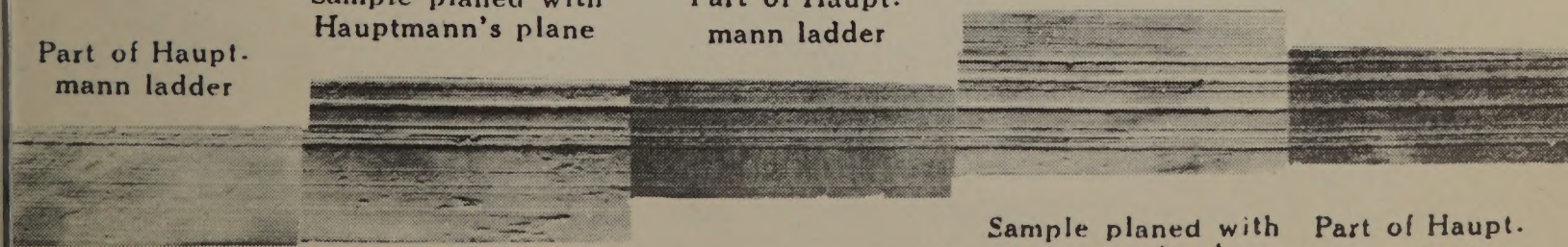
At the top of the page is a microscopic drawing of hardwood cells. Below this are magnified cross sections of yellow birch, mahogany, and red gum, woods much used for furniture. When stained alike they often are exceedingly difficult to distinguish from each other. The wood technologist, however, has positive means of distinguishing these and other species of wood.



**THE PHOTOGRAPHS BELOW** reveal graphically the important part played by Laboratory experts in the conviction of Bruno Hauptmann as the kidnapper of the Lindbergh baby.

Part of Hauptmann ladder      Sample planed with Hauptmann's plane

Part of Hauptmann ladder



Sample planed with Hauptmann's plane      Part of Hauptmann ladder



# How To Use The Laboratory

**A**LL the information on wood utilization that the Forest Products Laboratory has gained through 25 years of research is available to the public. Every year hundreds of mail inquiries are answered and wood-utilization problems are discussed with those who come to the Laboratory seeking advice. If you are in doubt as to what kind of wood to use for a given purpose, how to make wood give better service or a better product, you are invited to take up your question with Laboratory specialists. The purpose of this institution is to aid the public in making the most efficient and satisfactory use of forest resources.

In cases where a problem of wood utilization is of such scope and difficulty as to warrant a cooperative research project, the work will be undertaken subject to advance agreement as to methods and cost. The purpose of such projects is not to promote one product as against any other, but to present facts which will enable the public and the industries to put wood to its best use.

Forest Products Laboratory publications are available which cover the main findings of its research work up to the present, and the Laboratory maintains classified mailing lists of those who wish to receive current information in different fields of wood use. Visitors are conducted through the Laboratory at regular hours.

The Laboratory will be glad to render any assistance possible in your wood-using problems. Inquiries should be addressed to the Director, Forest Products Laboratory, Madison, Wis.

